On the Notion of a Resource. Part 2

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Resources, Tools and State Changes

We worked out an **conceptional asymmetry between tool and workpiece**: The tool (as a component within the system) provides a *main useful function* that is applied to change the state of the workpiece. The state of the tool remains (at least conceptually) unchanged.

In SF-modelling this asymmetry moves into the background, but the state-change is rather matter of the **action** (as „pure functionality“ of the Ideal Machine – the machine disappeares) and no more the tool.

This matches the component concept as proposed by C. Szyperski for Component Software.

Components and Objects according to Szyperski

Components (which are „for composition“) are conceptualised

- as unit of independent deployment,
- as unit of third party composition
- having no (externally) observable state.

In contrast to this *Objects* are conceptualised

- as unit of instantiation,
- that may have externally observable states
- and encapsulates its state and behaviour.

Instantiation is important to maintain a certain standardisation of workpieces required for a repeated application of a function within a production process.

The World of Technical Systems

The operational demand of a technical system is formulated in the form of *specifications* as requirements to the "environment", which must be fulfilled for the *operation* of the system. Thus the "reduction to the essentials" that characterises the systemic approach is only a *conditional* mind game that presupposes a sufficiently powerful *environment* as given, in which the necessary *resources* can be found to fulfil the operating conditions.

Sommerville emphasises the importance of such interface specification for the development of software systems that "need to interoperate with other systems that have already been developed and installed in the environment."

Components as Resources and Component Models

The same perspective is significant when large systems are to be created in a cooperative development process and for this a decomposition into subsystems is required that are to be developed independently of each other.

This development process in turn requires a more extensive socio-technical infrastructure with

1. *independent components* that can be fully configured via their interfaces,
2. *standards for components* that simplify their integration,
3. a *middleware*, which supports the component integration with software
4. and a *development process* that is designed for component-based software engineering.

Components as Resources and Component Models

Components are thus conceptually integrated into an overarching *component model*, which essentially ensures the technical interoperability of different components beyond concrete interface specifications and thus forms a moment of unity in the diversity of the components.

However, this unity extends not only to the model, but also to the operating conditions of the components (as functional property of the middleware) as well as to their socio-technical development conditions (as a partial formalisation of the development process).

This frame constitutes as *component framework* (Szyperski) a socio-technical supersystem as an "environment" of components that were created according to the specifications of that component model.

The World of Component Models

Szyperski, for his part, analyses this diversity of compatibilities and incompatibilities of different component models and identifies different levels of abstraction for the reuse of concepts that go beyond the use of prefabricated components.

In his 20-year-old book he already emphasises

> *the growing importance of component deployment, and the relationship between components and services, the distinction of deployable components (or just components) from deployed components (and, where important, the latter again from installed components). Component instances are always the result of instantiating an installed component – even if installed on the fly. Services are different from components in that they require a service provider.*

Functional and Attributive Properties

Szyperski shows that the component approach is an approach of reuse that is not limited to the (possibly modified) abstract reuse of the technical functionality of a problem solution, but always reuses components together with their operating conditions as *services* and thus not detached from their environment.

For this, Shchedrovitsky's distinction between functional and attributive properties as well as the distinction between the notions of *part* and *element* are essential.

> **Elements** *are what a unity is made up of, so an element is a part inside the whole, which functions inside the unity, without as it were being torn out of it. A simple body, a* **part**, *is what we have when everything has been disassembled and is laid out separately. But elements only exist within the structure of* **connections**. *So an element implies two principally different types of properties: its properties as material, and its functional property derived from connections.*

Functional and Attributive Properties

In other words, an element is not a part. A part exists when we mechanically divide something up, so that each part exists on its own as a simple body. An element is what exists in connections within the structure of the whole and functions there. [. . .]

Functional properties *belong to an element to the extent that it belongs to the structure with connections, while other properties belong to the element itself. If I take out this piece of material, it preserves its* **attributive properties**. *They do not depend on whether I take it out of the system or put it into the system. But functional properties depend on whether or not there are connections. They belong to the element, but they are created by a connection; they are brought to the element by connections.*

Filling the Places with Content

The terms *part*, *element*, *connection* describe the *structure* of the place in the system itself, where the connection of the "dead" system with the "living" world must be carried out in order to bring the system itself to life.

In the further system genesis, this conceptual frame has to be filled with suitable resources. How conceptualise this "filling", the combination of the functional properties at the "connections" with resources to an almost ideal machine?

To describe this composition process ("components are for composition" – Szyperski) Shchedrovitsky distinguishes the concepts *place* and *content*.

Filling the Places with Content

Doing that, we introduce the concepts of place and content. An **element** *is a unity of a place and its content – the unity of a functional place, or a place in the structure, and what fills this place.*

A **place** *is something that possesses functional properties. If we take away the content, take it out of the structure, the place will remain in the structure, held there by* **connections***. The place bears the totality of functional properties.*

The **content** *by contrast is something that has attributive functions. Attributive functions are those that are retained by the content of a place, when this content is taken out of the given structure. We never know whether these are its properties from another system or not. Now we might take something out as content, but it is in fact tied to another system, which, as it were, extends through this place.*

Filling the Places with Content

The search for resources is constitutive for the process of confinement in the course of the genesis of the system that is to be developed from the pure functionality of the ideal machine. This corresponds to Altshuller's first law of systemic development.

Altshuller's Law of the Completeness of the Parts of a System

The necessary condition for the viability of a technical system is the existence of the main parts of the system **and** their minimal functionality (i.e. viability – HGG).

However, the thing viewed with the magnifying glass as a connection of place and content remains a "dead body", because "a living being has no parts" (Shchedrovitsky).

Connecting Systems. The Operational Dimension

It is of little use to dissect a living frog in order to see how place and content are to be combined, since you cannot study the blood flow in its veins this way.

It is not enough that the plug fits into the socket, the socket must also "have power in it".

Beyond the connection of place and content an operational process dimension is essential for a living system. Shchedrovitsky develops that as a *second concept of a system*. This cannot be explained here.

We are dealing with a typical phenomenon of a modern society, in which the electricity comes from the socket and the milk from the shop. The division of labour in such a modern mode of production leads to the emergent phenomenon of social unity and stratification of the reproduction of infrastructural conditions.

Connecting Systems. The Operational Dimension

The existence, reliability and robustness (resilience) of such an infrastructure has a significant influence on the way people organise their daily lives.

With the insight into ever more complex interrelationships, a concept of resources as "anything in or around the system that is not being used to its maximum potential" (Mann, Salamatov), which focuses on the *exploitation* of resources, becomes increasingly counterproductive and has to be replaced by a concept of resources with socio-culturally institutionalised forms of *resource management* at its center.

The Concept of a Resource and the Mode of Production

Thesis:

The concept of resource exploitation is a characteristic feature of all existing so far forms of a capitalist mode of production.

It manifests a fundamental contradiction of socio-cultural development: without such exploitation we would not have reached the current state of technology, but at the same time we undermine our own conditions of existence.

My historical optimism says that it is nevertheless precisely these means of increasing conceptual penetration of ever increasingly complex interrelationships by which this trend can be stopped and eventually reversed.

The Global Scope of Local Action

The formulated contradiction is of a global, planetary dimension that cannot be solved by the regional disposition of individual power groups over exploitable resources. The division of the world into spheres of influence thus becomes obsolete insofar as in each of these spheres of influence, the transition to a different form of using resources must be organised to avoid a global environmental collapse of the resources used by mankind in the long run.

TRIZ systemic evolution trends of increasing coordination, controllability and dynamisation refer not only to *system-internal development lines*, but also to the coordination *between* systems which are operated by independent third parties.

Qualifying the infrastructural framework, for example, of the power supply system as "supersystem" does not take into account the relations of *mutual interdependency* in such a modern industrial mode of production.